

Durham Research Online

Deposited in DRO:

01 July 2015

Version of attached file:

Presentation

Peer-review status of attached file:

Not peer-reviewed

Citation for published item:

Beckmann, J.F. and Goode, N. (2013) 'On costs of good intentions : the effect of problem contextualisation on knowledge acquisition.', 15th Biennial Conference of the European Association for Learning and Instruction. Munich, Germany, 27-31 August 2013.

Further information on publisher's website:

<http://www.earli2013.org/>

Publisher's copyright statement:

Additional information:

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in DRO
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full DRO policy](#) for further details.

On costs of good intentions:

The detrimental effect of problem contextualisation on learning

Jens Beckmann
Natassia Goode

j.beckmann@durham.ac.uk

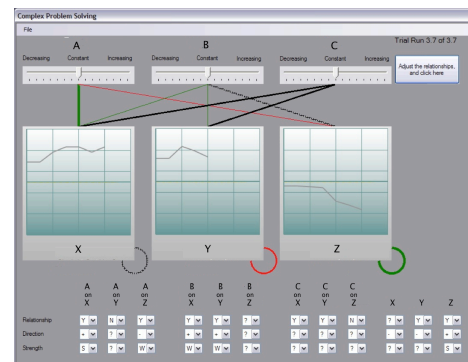
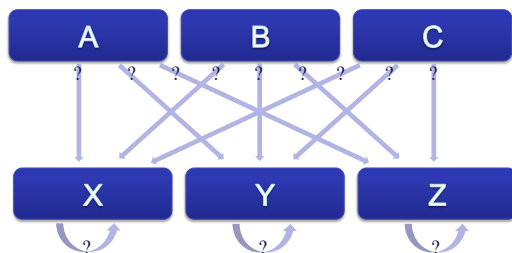


Beckmann, J.F., & Goode, N. (2013, 26 – 31 August). *On costs of good intentions: The effect of problem contextualisation on knowledge acquisition*. Paper presented at the 15th Biennial Conference of the European Association for Learning and Instruction, Munich, Germany.

Complex Problem Solving

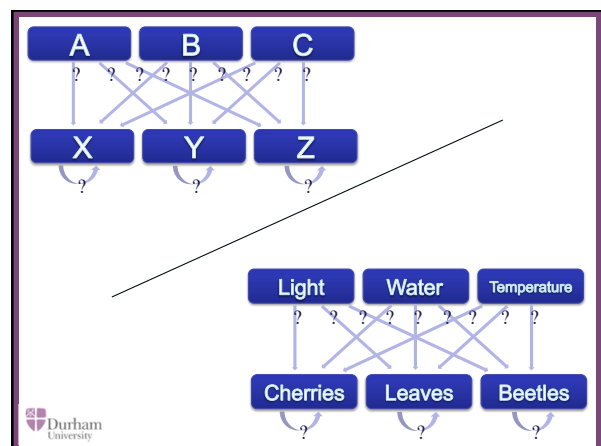
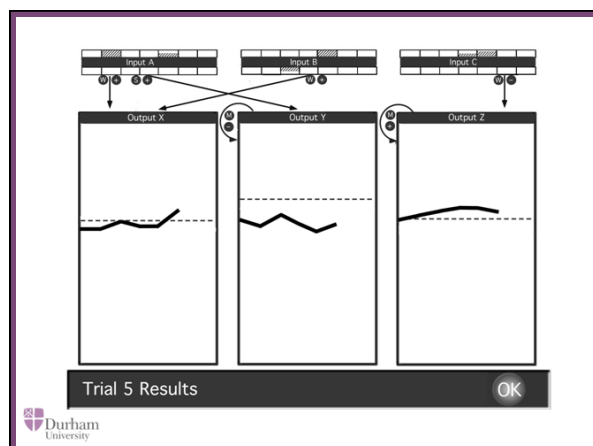
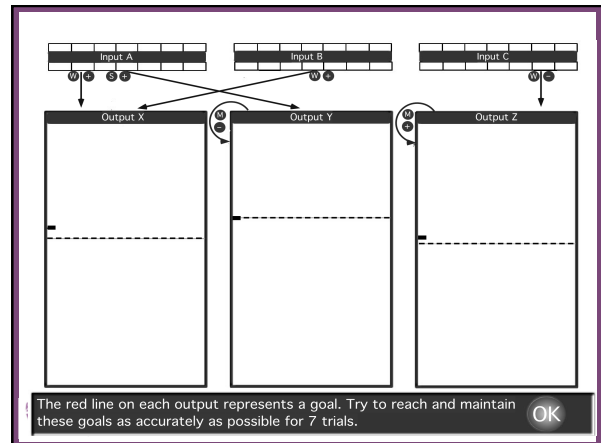
To study information processing, decision making, intelligence, knowledge acquisition, learning ...

Complex, dynamic problems change as a result of the decisions made by the problem solver, as well as autonomously.



Learning Task

1. Acquire knowledge about the causal structure
 - Direct learning task
 - Rule induction
 - Systematic interaction / experimentation
 2. Apply knowledge to control the system
 - Indirect learning task
 - Utilisation of rule knowledge acquired to reach and maintain set target values in output variables
 - Knowledge based and goal orientated interaction
- Generic problem solving skill central to scientific enquiry:
drawing causal inferences based on systematic experimentation



... in favour of the cherry tree?

- Common view held by educationalists, teachers, instructional designers ...
- Goldstone & Sakamoto (2003): the use of variable labels referring to familiar contexts facilitates the understanding of abstract scientific concepts (see also Lazonder, Wilhelm & Hagemans, 2008; Lazonder, Wilhelm & Van Lieburg, 2009)
- Reference to prior knowledge helps generating hypotheses that can be tested
- Sense of familiarity is considered helpful



... well, maybe not!

- Beckmann, 1994; Beckmann & Guthke, 1995; Burns & Vollmeyer, 2002;
- Lazonder, Wilhelm & Hagemans, 2008*; Lazonder, Wilhelm & Van Lieburg, 2009*
- Poorer performance under "semantically meaningful" conditions

→ Semantic Effect



Aim

Why is the acquisition of *new* knowledge inhibited by a "semantically meaningful" context?

Two explanatory mechanisms:

- Goal Adoption
 - despite instruction to explore problem solvers tend to adopt goals (i.e. self-defined optimisation of values in output variables)
- Presumptions
 - Semantic contexts induces sense of familiarity
 - Familiarity triggers assumptions
 - Testing of assumptions is cognitively more demanding than seeking for confirmation



Design

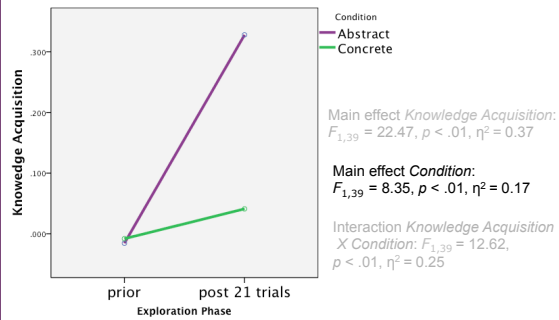
N	Condition	Input	Output
21	abstract	A	X
		B	Y
		C	Z

20	concrete	Light Water Temperature	Cherries Leaves Beetles
----	----------	-------------------------------	-------------------------------

Age: 18 – 48 (20, 5)
Sex: 72 % female



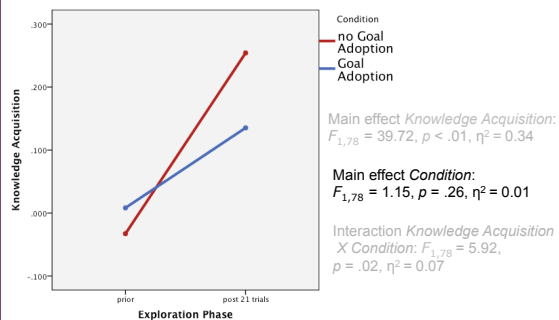
Results (Replication Semantic Effect)



Design

N	Condition	Input	Output	
21	abstract	A B C	X Y Z	Goal Adoption unlikely
19	abstract output	Light Water Temperature	X Y Z	
20	concrete output	A B C	Cherries Leaves Beetles	Goal Adoption likely
20	concrete	Light Water Temperature	Cherries Leaves Beetles	

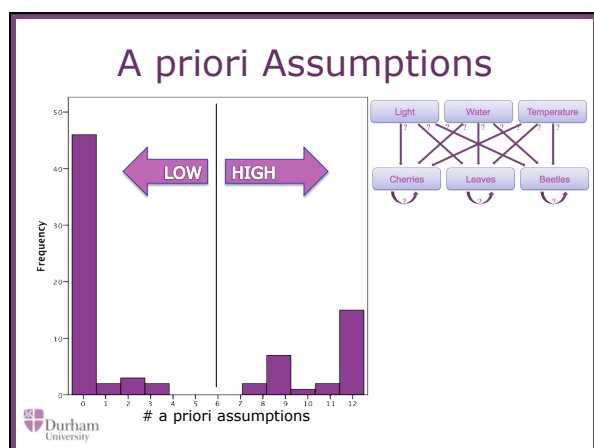
Results (Goal Adoption)



Design

N	Condition	Input	Output
21	Abstract in & out	A B C	X Y Z
19	Abstract output	Light Water Temperature	X Y Z
20	Concrete output	A B C	Cherries Leaves Beetles
20	Concrete in & out	Light Water Temperature	Cherries Leaves Beetles

Semanticity

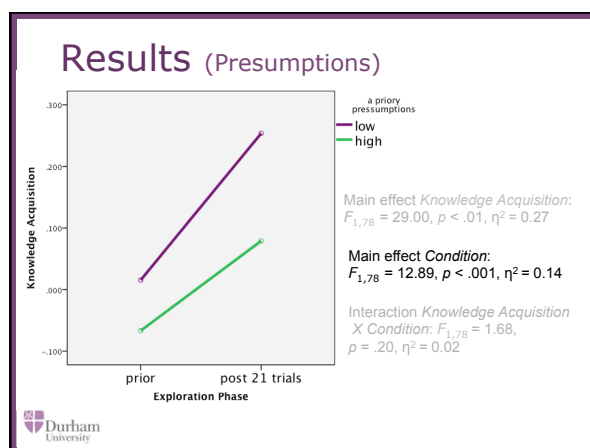
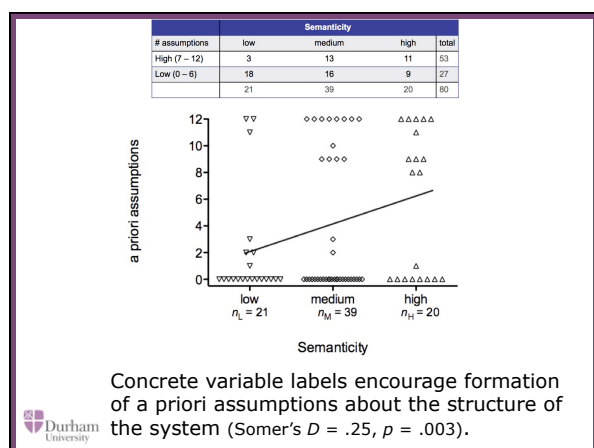


A priori Assumptions

	Conditions				
# assumptions	Abstract in & out	Concrete out	Abstract out	Concrete in & out	total
High (7 – 12)	3	5	8	11	27
Low (0 – 6)	18	15	11	9	53
	21	20	19	20	80

	Semanticity			
# assumptions	low	medium	high	total
High (7 – 12)	3	13	11	53
Low (0 – 6)	18	16	9	27
	21	39	20	80

Durham University logo is at the bottom left.



Results Summary

Goal Adoption?

- contrast b/w conditions with concrete and abstract labels for outputs
- Knowledge acquisition: $F_{1,78} = 3.48, p = .07, \eta^2 = 0.04$
- System control: $F_{1,78} = 1.38, p = .24, \eta^2 = 0.02$

Presumptions?

- higher levels of semanticity increases significantly the likelihood to adopt high numbers of presumptions (Somer's $D = .25, p = .003$)
- contrast b/w high and low levels of a priori assumptions
- Knowledge acquisition: $F_{1,78} = 12.89, p < .01, \eta^2 = 0.14$
- System control: $F_{1,78} = 24.60, p < .01, \eta^2 = 0.24$



Systematicity

- **only 4 interventions are necessary** to completely identify the underlying causal structure
 - Leave all inputs at zero → identifies autonomic changes
 - Vary one input at a time → identifies effects of inputs on each output
 - Combined: Vary One or None at A Time (**VONAT**) as indicator of **systematicity**
- **High levels of assumptions are associated with low levels of systematicity in exploration behaviour** ($r_{pb} = -.53, p < .001$)
- Low levels of systematicity is associated with low levels of accuracy of acquired knowledge ($r = .32, p = .002$).



Summary

Semantic effect replicated

No support for goal adoption as explanatory mechanism

Support for presumption hypothesis:

- Concrete labels induce sense of familiarity
- Familiarity generates presumptions
- **Presumptions are less likely to be tested systematically**
- Unsystematic exploration behaviour impedes knowledge acquisition
- Poor knowledge acquisition leads to poor system control



Implications

It is presumptuous to assume that hypotheses testing does occur "naturally" in learners.

- "instructional disobedience" or "instructional idealism"?
- challenge for constructivist, discovery, problem-based, experiential, and inquiry-based teaching
- guidance needed on how to (a) explicate assumptions and (b) test them systematically.

